

1. Product Overview

ZS3L is a low-power embedded Zigbee module that Tuya has developed. It consists of a highly integrated RF processor chip (EFR32MG21A020F768IM32-B) and several peripheral components, with an embedded 802.15.4 PHY/MAC Zigbee network protocol stack and robust library functions. ZS3L is embedded with a 32-bit low-power Arm Cortex-M33 core, 768 KB flash memory, and 64 KB random-access memory (RAM), and has extensive peripherals.

ZS3L is a FreeRTOS platform that integrates all the function libraries of the Zigbee MAC and TCP/IP protocols. You can develop embedded Zigbee products as required.

1.1 Features

- ✧ Embedded low-power 32-bit Arm Cortex-M33 processor, which provides digital signal processor (DSP) instructions and floating-point units (FPUs) and can also function as an application processor
 - Clock rate: 80 MHz
- ✧ Peripherals: nine GPIOs, one universal asynchronous receiver/transmitter (UART), and one analog-to-digital converter (ADC)
- ✧ White ink, black silkscreen; mounted onto a PCB by using an SMT placement machine or through-hole mounted onto the PCB through a pin header
- ✧ Zigbee features
- ✧ Working voltage: 2.0 V to 3.8 V
 - 802.15.4 MAC/PHY
 - Channels 11 to 26 at 2.400 GHz to 2.483 GHz, 250 kbit/s air interface rate
 - Maximum output power: +20 dBm; dynamic output power: > 35 dB
 - Runtime power consumption: 60 μ A/MHz; current in sleep mode: 5 μ A
 - Proactive device pairing for terminals

- Onboard PCB antenna
- Working temperature: -20°C to +105°C
- AES-128 or AES-256 hardware encryption

1.2 Application Scenarios

- ✧ Intelligent building
- ✧ Smart household and home appliances
- ✧ Smart socket and light
- ✧ Industrial wireless control
- ✧ Baby monitor
- ✧ Network camera
- ✧ Intelligent bus

Change History

No.	Date	Change Description	Version After Change
1	2019-12-10	This is the first release.	1.0.0
1	2019-12-18	Updated pin 3 description and antenna gain.	1.0.1

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2. Module Interfaces

2.1 Dimensions and Footprint

ZS3L has two rows of pins with a 2 ± 0.1 mm pin spacing.

The ZS3L dimensions (H x W x D) are 2.8 ± 0.15 mm x 24 ± 0.35 mm x 16 ± 0.35 mm. Figure 2-1 shows the ZS3L front and rear views.

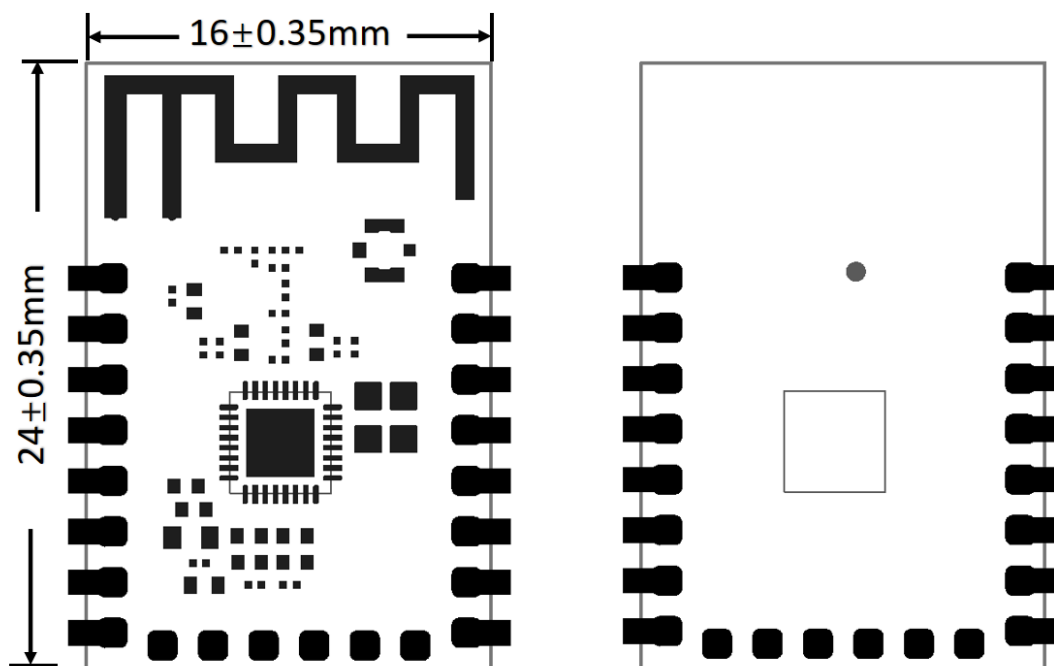


Figure 2-1 ZS3L front and rear views

2.2 Interface Pin Definition

Table 2-1 ZS3L interface pins

Pin No.	Symbol	I/O Type	Function
1	RST	Input	Hardware reset pin, which is at a high level by default and is active at a low level
2	ADC_PC01	I/O	12-bit SAR ADC pin
3	NC	Input	Disconnected, which can be used as the reset pin in special scenarios
4	PC00	I/O	Hardware PWM pin, which is connected to PC00 (pin 1) on the internal IC
5	PA00	I/O	Hardware PWM pin, which is connected to PA00 (pin 17) on

Pin No.	Symbol	I/O Type	Function
			the internal IC
6	PA03	I/O	Hardware PWM pin, which is connected to PA03 (pin 20) on the internal IC
7	PA04	I/O	Hardware PWM pin, which is connected to PA04 (pin 21) on the internal IC
8	3V3	P	Power supply pin (typical power supply voltage: 3.3 V)
9	GND	P	Power supply reference ground pin
10	PD01	I/O	Hardware PWM pin, which is connected to PD01 (pin 31) on the internal IC
11	PD00	I/O	Hardware PWM pin, which is connected to PD00 (pin 32) on the internal IC
12	PC02	I/O	Hardware PWM pin, which is connected to PC02 (pin 3) on the internal IC
13	PB00	I/O	Hardware PWM pin, which is connected to PB00 (pin 16) on the internal IC
14	PB01	I/O	Hardware PWM pin, which is connected to PB01 (pin 15) on the internal IC
15	RXD	I/O	UART_RXD, which is connected to PA06 (pin 23) on the internal IC
16	TXD	Input	UART_TXD, which is connected to PA05 (pin 22) on the internal IC

Note:

P indicates a power supply pin, and **I/O** indicates an input/output pin.

2.3 Test Pin Definition

Table 2-2 ZS3L test pins

Pin No.	Symbol	I/O Type	Function
17	3V3	P	Power supply pin (typical power supply voltage: 3.3 V)
18	SWDIO	I/O	J-Link SWDIO programming pin
19	SWCLK	I/O	J-Link SWCLK programming pin
20	GND1	P	Power supply reference ground pin
21	RST2	I/O	Hardware reset pin, which is at a high level by default and is active at a low level

Pin No.	Symbol	I/O Type	Function
22	GND2	P	Power supply reference ground pin

Note:

Test pins are not recommended.

3. Electrical Parameters

3.1 Absolute Electrical Parameters

Table 3-1 Absolute electrical parameters

Parameter	Description	Minimum Value	Maximum Value	Unit
Ts	Storage temperature	-20	105	°C
VBAT	Power supply voltage	3.0	3.6	V
Static electricity voltage (human body model)	Tamb = 25°C	N/A	2	kV
Static electricity voltage (machine model)	Tamb = 25°C	N/A	0.5	kV

3.2 Working Conditions

Table 3-2 Normal working conditions

Parameter	Description	Minimum Value	Average Value	Maximum Value (Typical Value)	Unit
Ta	Working temperature	-20	N/A	105	°C
VBAT	Power supply voltage	3.0	3.3	3.6	V
V _{IL}	I/O low-level input	-0.3	N/A	VCC x 0.25	V
V _{IH}	I/O high-level input	VCC x 0.75	N/A	VCC	V
V _{OL}	I/O low-level output	N/A	N/A	VCC x 0.1	V
V _{OH}	I/O high-level output	VCC x 0.8	N/A	VCC	V
I _{max}	I/O drive current	N/A	N/A	12	mA

3.3 RF Current Consumption

Table 3-3 Current consumption during constant transmission and receiving

Working Status	Parameter			Average Value	Maximum Value (Typical Value)	Unit
	Mode	Rate	TX Power/ Receiving			
TX		250 kbit/s	+20 dBm	200	206	mA
		250 kbit/s	+10 dBm	62	64	mA
		250 kbit/s	+0 dBm	26	28	mA
RX		250 kbit/s	Constant receiving	10	12	mA
		250 kbit/s	Constant receiving	10	12	mA
		250 kbit/s	Constant receiving	10	12	mA

3.4 Working Current

Table 3-4 Working current

Working Mode	Working Status (Ta = 25°C)	Average Value	Maximum Value (Typical Value)	Unit
EZ	The module is in EZ mode.	10	40	mA
Connected and idle	The module is connected to the network.	4.2	5	mA
Deep sleep mode	The module is in deep sleep mode, with 64 KB flash memory.	5		μA

4. RF Features

4.1 Basic RF Features

Table 4-1 Basic RF features

Parameter	Description
Frequency range	2.4 GHz to 2.4835 GHz
Zigbee standard	IEEE 802.15.4
Data transmission rate	250 kbit/s
Antenna type	PCB antenna with a gain of 1 dBi

4.2 TX Performance

Table 4-2 Performance during constant transmission

Parameter		Minimum Value	Average Value	Maximum Value (Typical Value)	Unit
Maximum output power	250 kbit/s	N/A	20	N/A	dBm
Minimum output power	250 kbit/s		-30		dBm
Output power adjustment step			0.5	1	dBm
Output spectrum adjacent-channel rejection ratio			-31		dBc
Frequency error		-15	N/A	+15	ppm

4.3 RX Performance

Table 4-3 RX sensitivity

Parameter		Minimum Value	Average Value	Maximum Value (Typical Value)	Unit
PER < 10%, 802.11n OFDM mode	250 kbit/s	-102	-101	-99	dBm

5. Antenna Information

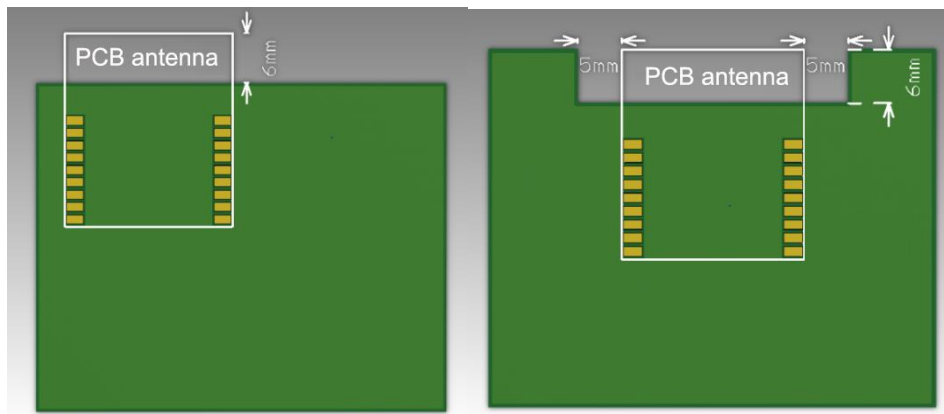
5.1 Antenna Type

ZS3L uses an onboard PCB antenna

5.2 Antenna Interference Reduction

To ensure optimal Zigbee performance when the Zigbee module uses an onboard PCB antenna, it is recommended that the antenna be at least 5 mm away from other metal parts.

To prevent adverse impact on the antenna radiation performance, avoid copper or traces along the antenna area on the PCB.



6. Packaging Information and Production Instructions

6.1 Mechanical Dimensions

The PCB dimensions (H x W x D) are 2.8 ± 0.15 mm x 24 ± 0.35 mm x 16 ± 0.35 mm.

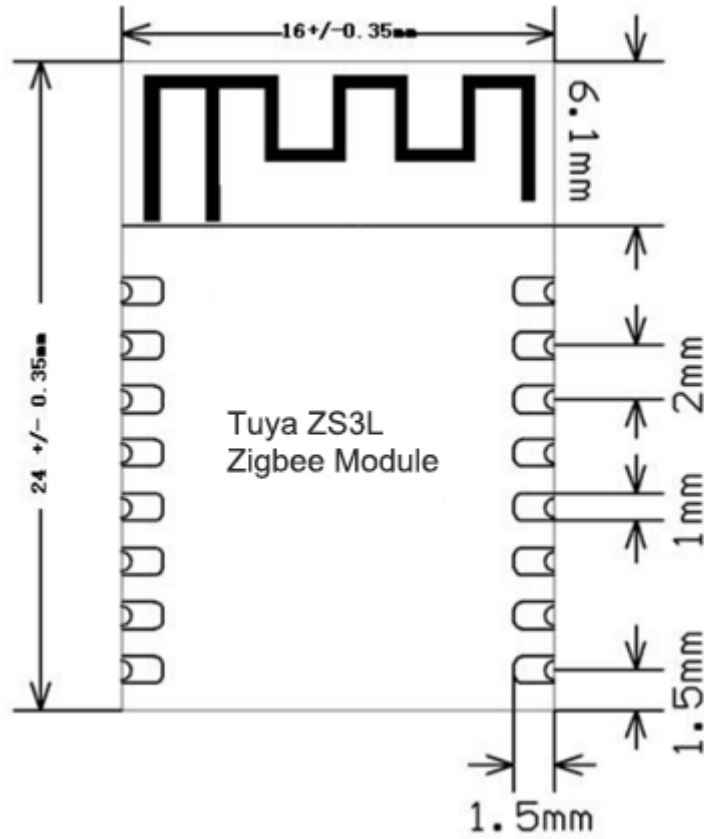


Figure 6-1 ZS3L mechanical dimensions

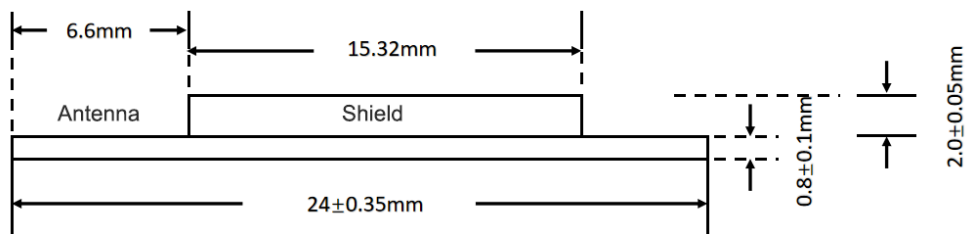


Figure 6-2 Side view

6.2 Recommended PCB Layout

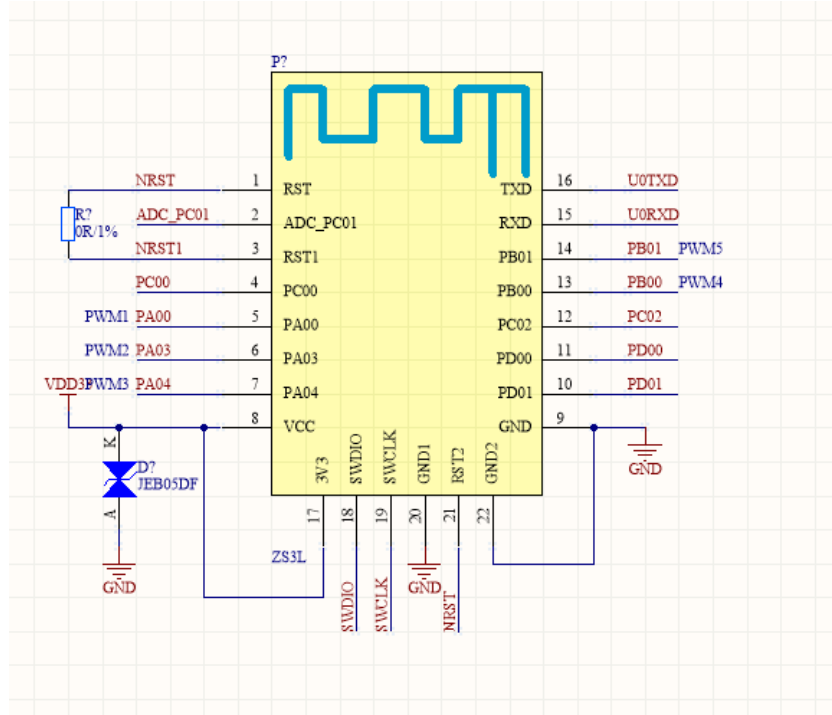


Figure 6-3 ZS3L pins

ZS3L can be mounted onto a PCB by using an SMT placement machine or through-hole mounted onto the PCB through a pin header. Figure 6-4 shows the pin header dimensions.

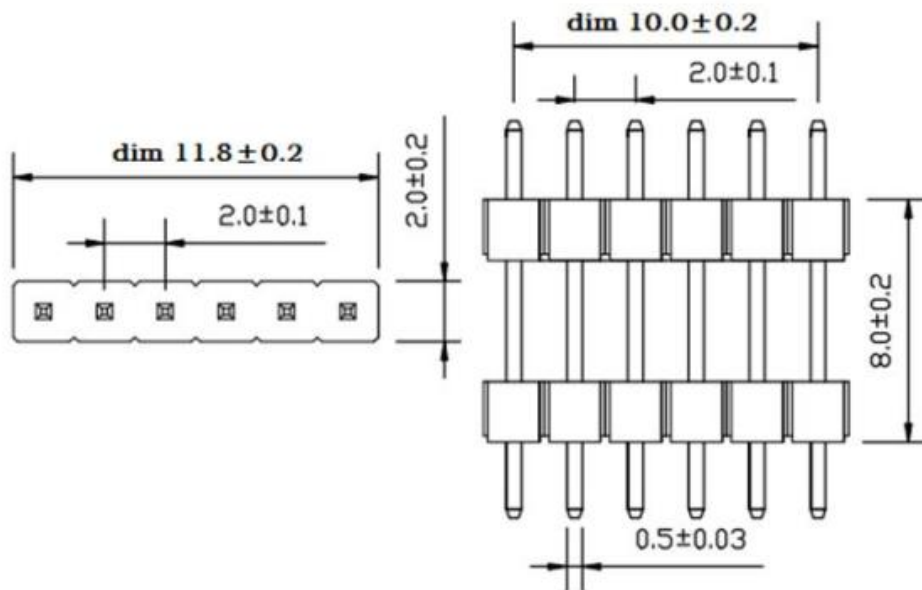


Figure 6-4 ZS3L pin header dimensions

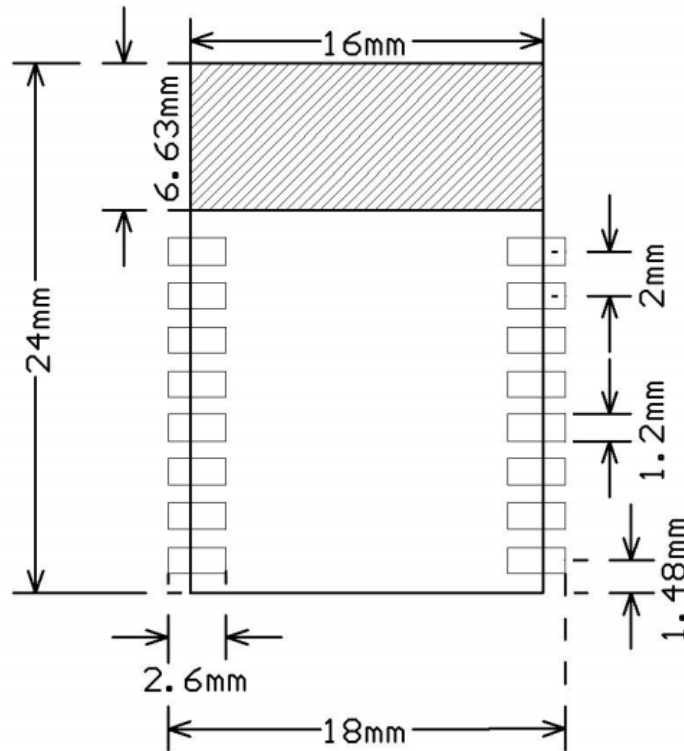


Figure 6-5 Layout of the PCB to which ZS3L applies

6.3 Production Instructions

1. Use an SMT placement machine to mount the stamp hole module that Tuya produces onto the PCB within 24 hours after the module is unpacked and the firmware is burned. If not, vacuum pack the module again. Bake the module before mounting it onto the PCB.
 - (1) SMT placement equipment
 - i. Reflow soldering machine
 - ii. Automated optical inspection (AOI) equipment
 - iii. Nozzle with a 6 mm to 8 mm diameter
 - (2) Baking equipment
 - i. Cabinet oven
 - ii. Anti-static heat-resistant trays
 - iii. Anti-static heat-resistant gloves
2. Storage conditions for a delivered module are as follows:
 - (1) The moisture-proof bag is placed in an environment where the temperature is below 30°C and the relative humidity is lower than 70%.

- (2) The shelf life of a dry-packaged product is six months from the date when the product is packaged and sealed.
- (3) The package contains a humidity indicator card (HIC).

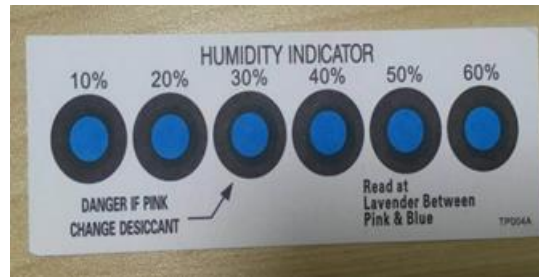


Figure 6-6 HIC for ZS3L

3. Bake a module based on HIC status as follows when you unpack the module package:
 - (1) If the 30%, 40%, and 50% circles are blue, bake the module for 2 consecutive hours.
 - (2) If the 30% circle is pink, bake the module for 4 consecutive hours.
 - (3) If the 30% and 40% circles are pink, bake the module for 6 consecutive hours.
 - (4) If the 30%, 40%, and 50% circles are pink, bake the module for 12 consecutive hours.
4. Baking settings:
 - (1) Baking temperature: $125\pm 5^{\circ}\text{C}$
 - (2) Alarm temperature: 130°C
 - (3) SMT placement ready temperature after natural cooling: $< 36^{\circ}\text{C}$
 - (4) Number of drying times: 1
 - (5) Rebaking condition: The module is not soldered within 12 hours after baking.
5. Do not use SMT to process modules that have been unpacked for over three months. Electroless nickel immersion gold (ENIG) is used for the PCBs. If the solder pads are exposed to the air for over three months, they will be oxidized severely and dry joints or solder skips may occur. Tuya is not liable for such problems and consequences.
6. Before SMT placement, take electrostatic discharge (ESD) protective measures.
7. To reduce the reflow defect rate, draw 10% of the products for visual inspection and AOI before first SMT placement to determine a proper oven temperature and component placement method. Draw 5 to 10 modules every hour from subsequent batches for visual inspection and AOI.

6.4 Recommended Oven Temperature Curve

Perform SMT placement based on the following reflow oven temperature curve. The

highest temperature is 245°C.

Refer to IPC/JEDEC standard; Peak Temperature: <math><245^{\circ}\text{C}</math>; Number of Times: ≤ 2 times;

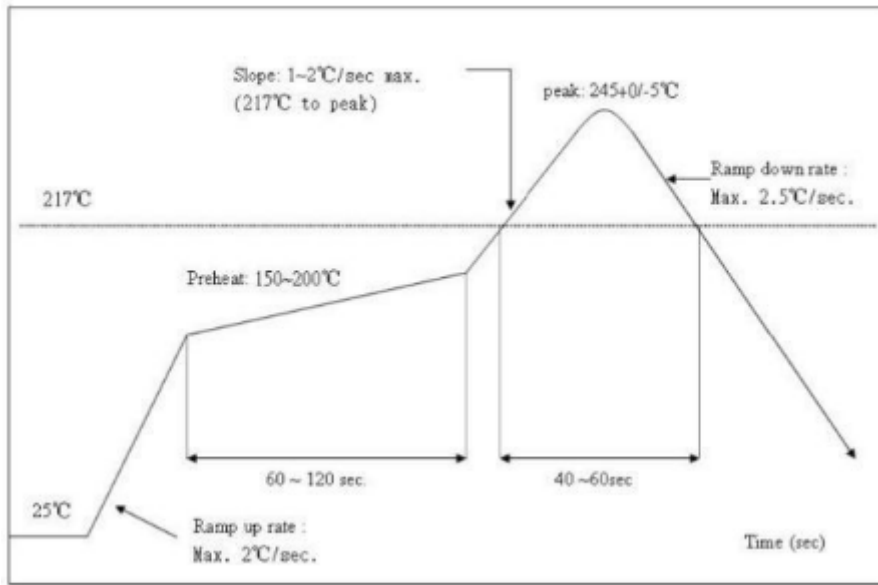


Figure 6-7 Oven temperature curve

6.5 Storage Conditions

	<p>CAUTION This bag contains MOISTURE-SENSITIVE DEVICES</p>	<p>LEVEL 3</p>
<p>If Blank, see adjacent bar code label</p>		
<p>1. Calculated shelf life in sealed bag: 12 months at < 40°C and < 90% relative humidity (RH)</p>		
<p>2. Peak package body temperature: <u>260</u> °C <small>If Blank, see adjacent bar code label</small></p>		
<p>3. After bag is opened, devices that will be subjected to reflow solder or other high temperature process must</p>		
<p>a) Mounted within: <u>168</u> hrs. of factory conditions <small>If Blank, see adjacent bar code label</small></p>		
<p>≤ 30°C/60%RH, OR</p>		
<p>b) Stored at <10% RH</p>		
<p>4. Devices require bake, before mounting, if:</p>		
<p>a) Humidity Indicator Card is > 10% when read at 23 ± 5°C</p>		
<p>b) 3a or 3b not met.</p>		
<p>5. If baking is required, devices may be baked for 48 hrs. at 125 ± 5°C</p>		
<p>Note: If device containers cannot be subjected to high temperature or shorter bake times are desired, reference IPC/JEDEC J-STD-033 for bake procedure</p>		
<p>Bag Seal Date: _____ <small>If Blank, see adjacent bar code label</small></p>		
<p>Note: Level and body temperature defined by IPC/JEDEC J-STD-020</p>		

7. MOQ and Packing Information

MOQ and packing information				
Product Model	MOQ	Packing Method	Number of Modules in Each Reel Pack	Number of Reel Packs in Each Box
ZS3L	4000	Carrier tape and reel packing	1000	4

8. Appendix: Statement

Federal Communications Commission (FCC) Declaration of Conformity

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled rolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body.

Important Note

This radio module must not be installed to co-locate and operating simultaneously with other radios in host system except in accordance with FCC multi-transmitter product procedures. Additional testing and equipment authorization may be required to operating simultaneously with other radio.

The availability of some specific channels and/or operational frequency bands are country dependent and are firmware programmed at the factory to match the intended destination. The firmware setting is not accessible by the end user.

The host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. The final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

The end user manual shall include all required regulatory information/warning as shown in

this manual, including: This product must be installed and operated with a minimum distance of 20 cm between the radiator and user body.

This device have got a FCC ID: 2ANDL-ZS3L.The final end product must be labeled in a visible area with the following: “Contains Transmitter Module FCC ID:2ANDL-ZS3L”

This device is intended only for OEM integrators under the following conditions:

1) The antenna must be installed such that 20cm is maintained between the antenna and users, and

2) The transmitter module may not be co-located with any other transmitter or antenna.

As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

Declaration of Conformity European notice



Hereby, Hangzhou Tuya Information Technology Co., Ltd declares that this module product is in compliance with essential requirements and other relevant provisions of Directive 2014/53/EU,2011/65/EU.A copy of the Declaration of conformity can be found at <https://www.tuya.com>



This product must not be disposed of as normal household waste, in accordance with EU directive for waste electrical and electronic equipment (WEEE- 2012/19/EU). Instead, it should be disposed of by returning it to the point of sale, or to a municipal recycling collection point.

The device could be used with a separation distance of 20cm to the human body.

	AT	BE	BG	HR	CY	CZ	DK
	EE	FI	FR	DE	EL	HU	IE
	IT	LV	LT	LU	MT	NL	PL
	PT	RO	SK	SI	ES	SE	UK